Regional Operations Centre
Canadian Coast Guard – Pacific

PACIFIC REGION CCG VESSEL - POST CRUISE REPORT

Line P Program – Fisheries and Oceans Canada

NAME OF SHIP/PLATFORM: John P Tully

DATE: **FROM:** 06 February 2012 **TO:** 21 February 2012

SCIENCE CRUISE NUMBER: 2012-01 **SHIP'S PATROL NUMBER:** 11-12

CHIEF SCIENTIST[S]: Marie Robert

SCIENTIFIC PERSONNEL:

Female	Male
Rhiana Bams (UVic)	Michael Arychuk (IOS)
Monica Torres Beltran (UBC)	Doug Bell (BIOS)
Marie Robert (IOS)	Dave Capelle (UBC)
Nina Schuback (UBC)	Glenn Cooper (IOS)
Gillian Stewart (CUNY)	Roger P. Kelly (URI)
	Hugh Maclean (IOS)
	Kenny Scozzafava (IOS)
	Kyle Simpson (IOS)
	Philippe Tortell (UBC)
	Ian Wylie (Volunteer)
	Doug Yelland (IOS)

AREAS OF OPERATION: North East Pacific, Line P, Station P.

INTRODUCTION/PROGRAM BACKGROUND: Line P is a long standing program which surveys a 1400 km long section 3 times annually. Data has been collected along this line since 1956 and shows evidence of the impact of climate variability on ocean productivity. It is the only Canadian long time-series that allows scientists to monitor climate changes in the Pacific Ocean. It is also the best opportunity for other programs (e.g. Universities) to do research in the Pacific since the Line P data give them background as well as current water properties.

This cruise (2012-01) could be nick-named the "Gremlin cruise". Every day brought a new illness, delay, break of equipment, or simply yet another bad weather system. Many stations were skipped and casts were cancelled. Despite it all, we managed to get some valuable data and most of the work planned for the major stations, thanks to the Captain and Chief Officer and their remarkable skills with weather planning. Thanks to everyone for staying in good spirits!

CRUISE OBJECTIVE/OBJECTIVES: Repeat hydrography section. Deploy two MetOcean floats for IOS, two Iridium floats for University of Washington, and two weather data drifting buoy for Environment Canada. Perform a Drifting Sediment Trap Experiment.

DAYS ALLOCATED: 15 **DAYS OF OPERATION:** 12

DAYS LOST DUE TO WEATHER: 3 hours at P4. 15 hours at P18. ~3 hours P16 to P24.

SAMPLING:

- The Line P survey was only about 65% successful. Only 17 of the planned 28 stations were visited and only 58 of the planned 79 profiles got done, due to a mix of bad weather, lack of time, and personnel sickness. The drifting sediment trap experiment got cancelled due to weather.
- One MetOcean float was deployed for DFO/IOS at P26. We are unsure at this time if the float will function properly or not. Two Iridium floats were deployed at P26 for the University of Washington/Applied Physics Lab. Both seem to be functioning properly. One MetOcean float deployment at P21 got cancelled. Out of the two weather data drifting buoys of Environment Canada, one got deployed in the vicinity of P24.
- The set-up for the *in-situ* pumps, using the same winch as the bongos, worked well. The bongo weights and one of the five *in-situ* pumps got lost during their first use at station P4.
- The samples collected include:
  1) Underway: **IOS**: Thermosalinograph (Temperature, Salinity, Fluorescence), acoustic sounder; **UBC:** CO_2, O_2, Ar, N_2 and dimethylsulfide (DMS) using the MIMS (Membrane Inlet Mass Spectrometer), and Chlorophyll a fluorescence using a FiRe system (Fluorescence Induction Relaxation).
  2) "E-data" from CTD: Pressure, Temperature, Conductivity, Dissolved Oxygen, Transmissivity, Irradiance, Fluorescence.
  3) From the Rosette: **IOS:** dissolved oxygen, salinity, nutrients, chlorophyll, HPLC, DIC, Alk, pH – **UBC (Tortell, Capelle, Schuback, Beltran):** dissolved nitrogen (N_2), oxygen (O_2), hydrogen sulphide (H_2S), carbon dioxide (CO_2), argon (Ar), nitrous oxide (N_2O), number of cells per millilitre, bacterial genomic (DNA, RNA), Methane, DMS – **UVic (Bams):** Oxygen, O^{17}, ONAr (Oxygen, Nitrogen, Argon), DIC, DOC – **City Uni. NY, URI, BIOS (Stewart, Kelly, Bell):** Thorium, polonium, total Chlorophyll, 5µm Chlorophyll, total HPLC, 5µm HPLC, FCM, µplankton, primary production, size-fractionated particles.
  4) From the pump/Trace Metal X-Niskins: **IOS (Simpson):** Iron (Dissolved and Total dissolved, three different treatments), salinity, nutrients.
  5) **IOS (Yelland) and City Uni. NY (Stewart):** Zooplankton using vertical net hauls.

RADIOISOTOPE USE:

The following radioisotope was used in the Rad-Van: $H^{14}CO_3$. A single daughter stock was created with a volume of 30mls and total activity of 55.5MBq. A total of 4 wipe tests were conducted over the cruise. The first test was conducted before the stock was opened (2/6/12) on the ship. The second test was conducted after 1 week on the ship (2/13/12), and a third test was conducted after the final incubation and disposal of remaining daughter stock (2/18/12). The final wipe test was made once we docked at IOS (2/20/12). There were no incidences to report with any level of contamination. The only radioisotope left behind is the main stock(1.5ml – 55.5MBq remaining), kept at IOS for future cruises.

Doug Bell

PROBLEMS [SCIENTIFIC GEAR AND OPERATIONS]:

During one deep cast at Station P4, the winch operator noticed a noise from the winch while at about 125m on the downcast. He stopped the cast to investigate and discovered many loops of loose wire on the drum, somewhat of a "birds' nest". While trying the recover the rosette the signal to the deck unit got lost, so we had to reterminate the CTD cable. 150m of wire got cut.
At the same station, the Stewart group's *in-situ* pumps were used for the first time on this cruise. The bongo winch was used to deploy these floats, with the "bongo weights" left at the end of the wire to help keep the wire stable. Upon recovery it was discovered that the weights were gone, and the deepest pump had worked its way off the wire as well. The Stewart group had to sample only 4 depths for the reminder of the cruise, instead of the five depths planned. It is unclear how the weights and pump got lost; there was most likely a problem with the shackle holding the weights.

During heavy weather the ship was rolling very heavily. During one of these rolls the door of the freezer in the wet lab opened and some nutrients samples ended up on deck. Some tubes broke therefore these samples are lost. Other samples were intact but out of the freezer long enough to thaw. The data quality of these samples will probably be compromised.

The thermosalinograph stopped updating position a few times during the cruise. This problem also occurred during a few cruises in 2011.

The counter used for the radioactivity wipe tests in the Rad-Van was not functioning properly. Thanks to the engineer (Erica) for fixing it.

When originally connecting the bongos to the wire it was noticed that they had been used and put away 'dirty' (salt-covered and rusty), and with some parts missing. We managed to connect the net to the wire but problems cropped up later with a couple of rips appearing in the nets. It is believed that these were caused by the use of cotter pins and seizing wire on the shackles used. Normally a simple ring and pin with rounded clip is used, which would have prevented this tearing.

Doug Yelland.

SUCCESSES [SCIENTIFIC]:

There is a new indicator on the thermosalinograph screen that indicates if/when the ship's position is not updating as it should. Since the TSG did stop updating the position a few times, this window prevented the loss of too many data points.

RADIATION VAN REPORT:

Overall, the van was great to work in. The floor mats had been removed after previous suggestion, which kept the floor easy to clean and free of any contamination. Window covers were provided for light reduction, but they are rather difficult to snap into place. A scintillation counter was provided by IOS for wipe tests, however a stable power connection was difficult to maintain. This was noted before initial use of instrument and issues with power did not allow wipe tests to be read between 2/13-2/16, until a ship engineer was able to repair a faulty wire connection. After this repair, the instrument worked fine.

Doug Bell

PROBLEMS [SHIP'S EQUIPMENT/OPERATIONS/PLATFORM SUITABILITY]:

The loading plan at the beginning of the cruise was modified; instead of loading the scientific gear first, then the winches and containers, the scientific gear got loaded starting at 1400 or so in the afternoon. It is a slightly less efficient way of doing things since once the scientific gear is on board it has to be set-up and secured. By loading that gear first we can set-up and secure while the winches and containers are loaded.

Two of the science email accounts were not functioning properly during most of the cruise.

Many websites have been blocked when using the internet-at-sea system. Many of these sites are very useful, for example www.microsoft.com. Often drivers or updates are required on our computers and were not available during this cruise. The best example is the Virus Definition updates in order to protect our computers.

Also because of this new policy, people from different agencies or universities were not able to access their work email.

As usual, there were new crew working on the deck for this cruise. Although we do understand that everyone needs to be trained in every activity we do, we would like to stress the importance of having someone with experience operating the LARS when the weather is not good.

SUCCESSES [SHIP]:

The Captain and Chief Officer did an awesome job at interpreting the weather forecasts. Because of their amazing skills we managed to utilize weather windows that were quite short by being at the right place at the right time.

The Captain also used both engines very efficiently in order to allow us to be in the weather windows on time. Without the use of both engines, and because of all the delays at the beginning of the cruise, we never would have accomplished the work we managed to do. Thanks!

DELAYS [OTHER THAN WEATHER]:

~18 hours at beginning of cruise waiting for part and 2 people
~4 hours with techs on board for gyros off Victoria
~22 hours for Medical evacuation
~4 hours to clear the jetty for the refuelling of the *Ricker*.

SAFETY CONCERNS:

None.

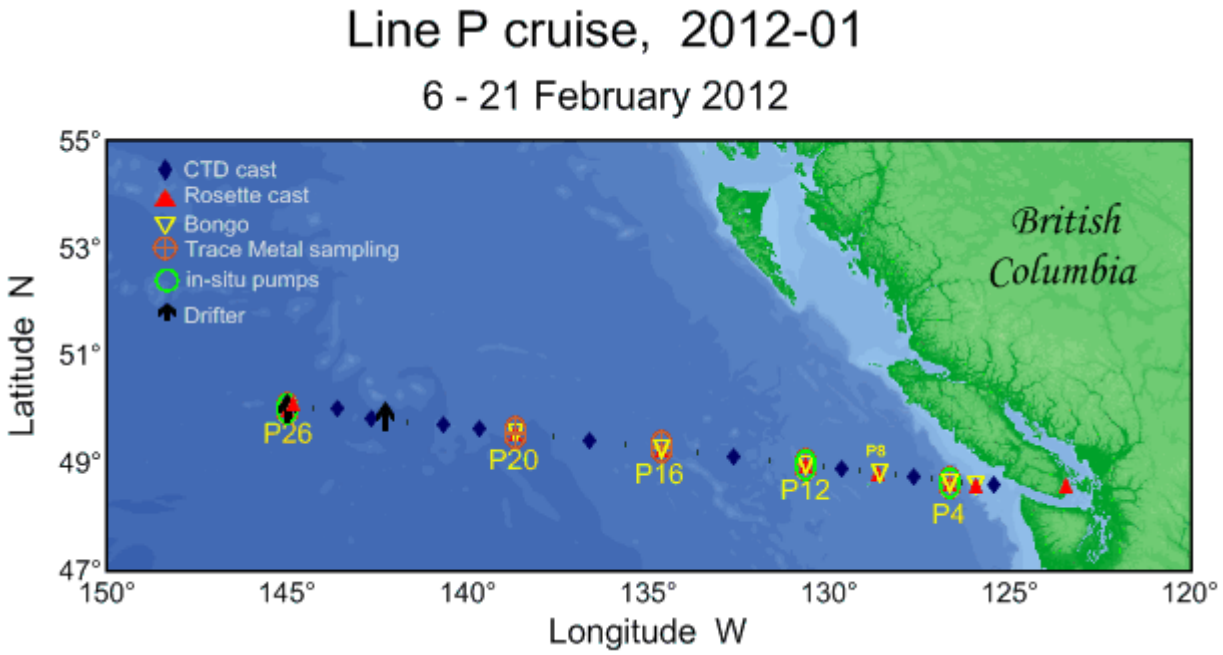
HAZARDOUS OCCURRENCES:

One scientist left the cruise on the second day because of flu-like symptoms.

EVENT LOG:

DATE		OPERATIONS
Monday	**6 Feb:**	**Start loading the ship at IOS around 1400.**
Tuesday	**7 Feb:**	**Leave IOS around 1400. Do the Saanich Inlet cast, leave for P1 around 1600.**
Wednesday	**8 Feb:**	**Do Station P2. Head to Victoria after breakfast for crew medical emergency.**
Thursday	**9 Feb:**	**Back to work at P4 around 1230. Stay at P4 for 17 hrs (3 hrs of weather delay)**
Friday	**10 Feb:**	**Stations P6, P8, P10.**
Saturday	**11 Feb:**	**Station P12 for ~14 hours.**
Sunday	**12 Feb:**	**Station P16 for ~8 hours.**
Monday	**13 Feb:**	**Sail through bad weather all day. SAR call quickly cancelled.**
Tuesday	**14 Feb:**	**P24 and P25. More bad weather.**
Wednesday	**15 Feb:**	**Station Papa from 0030 to 2030, then cast at mooring site PA-005. Sail east.**
Thursday	**16 Feb:**	**Deploy drifter for EC. Stations P22, P21, P20 for ~ 5 hours.**
Friday	**17 Feb:**	**Sail to P18. Wait for weather for ~18 hours.**
Saturday	**18 Feb:**	**P18, P14. Last station.**
Sunday	**19 Feb:**	**Burial at sea in Juan de Fuca Strait.**
Monday	**20 Feb:**	**Arrive at Pat Bay. Offload scientific gear, winches and containers.**
Tuesday	**21 Feb:**	***Ricker* refuelling.**

CRUISE TRACK:



SUMMARY/FINAL COMMENTS:

- We would like to thank everyone on board for such great help. As usual, help was always provided with a smile from all departments.
- Many thanks to everyone at IOS who have helped make this cruise a success: Janet, Nina, Melissa … your help is always greatly appreciated!
- Thanks to Captain Corfield for keeping in touch and sending updates during the SAR call previous to the cruise so that we could be ready on time to start loading our equipment. Thanks also for trying to catch up on the early delays by using both engines. It was greatly appreciated.
- Finally, a VERY special thank you to Kerri and her fantastic crew for cooking such wonderful meals despite the ship motion. It must have been nearly impossible to cook in these conditions, yet every day the menu was fantastic. Thanks!

Marie Robert and the science team.

We wish to thank the Tully crew for their assistance and excellent work throughout the cruise. Thanks to Marie Robert and the scientists onboard for their help on deck and in the lab.

Monica Torres Beltran

Thanks to the officers and crew of the John P. Tully for a successful cruise. Thanks and appreciation to the bosun and deck crew for assistance securing and deploying our equipment on the weather decks. We would also like to thank Marie Robert and the science party for their sampling assistance. Thanks to Mike Arychuk for assistance with inter-cruise chemical storage and handling. We'd also like to thank Darren Tuele, Janet Barwell-Clarke, and Hugh Maclean for help during pre- and post-cruise operations.

Roger P. Kelly, Gillian Stewart, Doug Bell

PROJECTS AND RESULTS:

Water masses. Marie Robert, DFO/IOS.

The waters along Line P were really comparable to the long term averages (1956 – 1991) in terms of temperature (Figure 1), salinity (Figure 2) and density (sigma-t) (Figure 3). The mixed layer depth was slightly shallower than in the past, as can be seen in the salinity anomaly and density anomaly graphs, but in general no important anomalies were present.

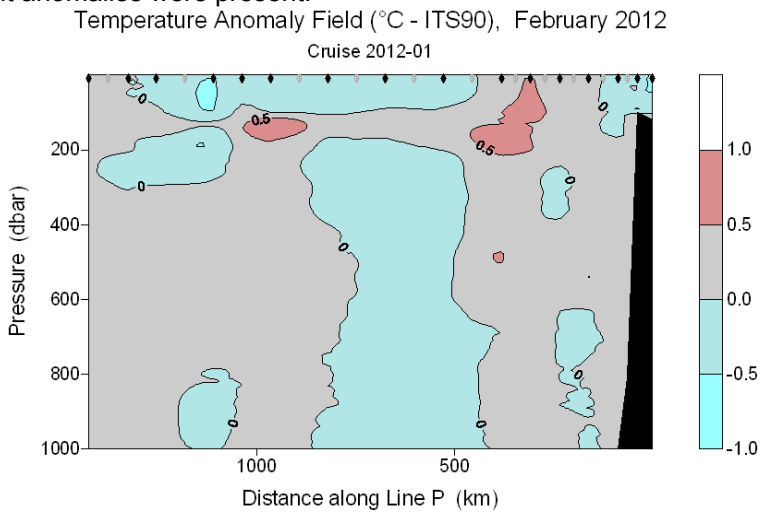


Figure 1: temperature anomaly field (°C) along Line P in February 2012 with respect to the 1956-1991 average.

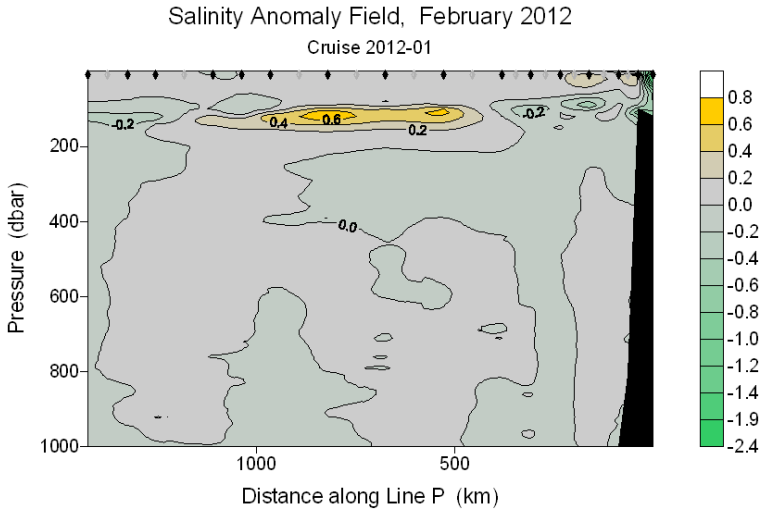


Figure 2: salinity anomaly field along Line P in February 2012 with respect to the 1956-1991 average.

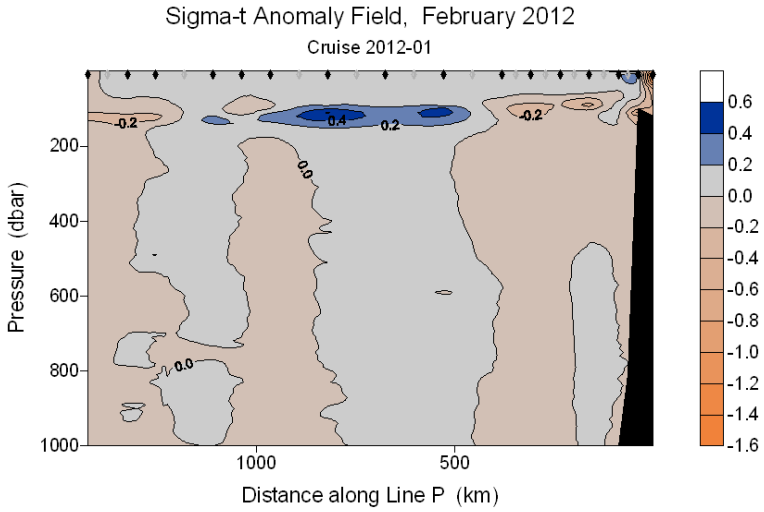


Figure 3: density (sigma-t) anomaly field along Line P in February 2012 with respect to the 1956-1991 average.

One thing that was quite noticeable around Papa was the amount of plastic and Styrofoam debris that were in the water, from the size of a ping pong ball to one Styrofoam cylinder that looked as big as a life raft (before deployment). Kyle Simpson saw something really resembling a window pane (see below). The Officers said that they started noticing the debris on about 12 February so around P16, but this was definitely the most they had seen so far. They also said that the debris seemed to be in bands of articles all of the same size. When at Papa, there would be a "pool" of very small debris, another one of articles about 1 square foot, and the big ones would just be scattered around on their own. We passed another "band" of 1 square foot debris around 49°45.38N, 141°15.13W on the way back.
While at Papa the 733 (small boat) was used for surface Trace Metal sampling. The crew picked up a couple of pieces of Styrofoam, but they are so destroyed that nothing could be known from them. Doug Bell did a wipe test of the Styrofoam for radioactivity and the test came back negative, as expected.

Zooplankton sampling – Doug Yelland, DFO/IOS.

13 bongo net tows were accomplished this cruise, 8 for IOS and 5 for CUNY. IOS samples were split between preserving in 10% buffered formalin and flash-freezing (-80C). CUNY samples were all preserved in formalin.

Note: when originally connecting the bongos to the wire it was noticed that they had been used and put away 'dirty' (salt-covered and rusty), and with some parts missing. We managed to connect the net to the wire but problems cropped up later with a couple of rips appearing in the nets. It is believed that these were caused by the use of cotter pins and seizing wire on the shackles used. Normally a simple ring and pin with rounded clip is used, which would have prevented this tearing.

Line P pH Cruise Report – Glenn Cooper, DFO/IOS.

Seawater pH was determined using the spectrophotometric method developed by Clayton and Byrne (Deep Sea Research, 1993). All samples were collected and analyzed by Glenn Cooper. pH was analyzed at the following major stations: P2, P4, P8, P12, P16, P20, and P26. A calibration cast was performed at station P24. At each major station, 2 sets of triplicates were taken to determine precision for the overall cruise. For the both the entire cruise and the calibration cast, precision was estimated at 0.0005 pH units.

The pH system was set up in the temperature control lab aboard the John P. Tully. Room temperatures were monitored and it was found best to set the air conditioning to turn on at 22.5^{o}C, due to the systems slow response time. Due to the considerably rough conditions experienced during the cruise it was difficult to retain water in the water bath. Having the temperature controlled room meant that sample temperatures didn't fluctuate significantly, aiding the analysis.

At the time of writing, pH calculations are based upon 25^{o}C sample temperature and salinity value are those from the CTD, obtained from the hydro file generated by Marie Robert for each sample depth.

Trace metal sampling and Carbonate Studies – Kyle Simpson, DFO/IOS.

Carbonate studies:

Objective: We are monitoring four aspects of the carbonate system on time series expeditions to Ocean Station Papa. Both pH (See Glenn Cooper's report) and underway continuous automated pCO2 are measured onboard the Tully, while samples for DIC and TA are collected preserved and returned to the laboratory for analysis.

1) pCO2

The pCO2 system was not brought on board the Tully for this trip as it was damaged in a flood at IOS and was not yet in working order.

2) DIC/TA Dissolved inorganic carbon and total alkalinity sampling

DIC/alkalinity samples were collected in pre-combusted 500ml bottles and preserved with 100ul of saturated $HgCl_2$ solution at stations P2, 4, 12, 16, 20, 26 and a calibration cast at P24. The glass stoppers were greased with Apiezon-m grease and taped closed with electrical tape. One duplicate was collected at each station between 1000 and 3000m as well as a duplicate bottle tripped at one of the deeper depths.

The calibration cast was conducted at P24 on the way to OSP (5 Niskins were tripped at 2000m and each sampled in triplicate). Sampling was carried out by Kyle Simpson and Marie Robert, a variety of personnel helped in the preservation step.

Trace metal:

The trace metal clean bench was set up in the wet lab to avoid damage due to the rough seas that are often encountered during the winter. This was the best approach as the boxes (X-Niskin crates and large Aluminium storage case) that we stowed and breeze way suffered considerable damage from wave impacts. The clean hood was used for all pumped samples (10-40m) and to fill 3 x 25L carboys (20m) at P26. All samples for both unfiltered and filtered (0.2u Opti cartridge) and bulk seawater sampling were collected into acid cleaned polyethylene containers. The Zodiac was used for subsurface sampling at station P26 only. On our way to station P26 (from about P16) it was noted that there was increasing amounts of debris in the water (Styrofoam, wood and even a window/door frame). We suspected that this debris likely originated from the Japanese earthquake/tsunami of March 11th 2011. Thus during this Zodiac trip we also collected a few pieces of floating debris (Styrofoam) for analysis by other groups.

Sampling was focused on the major Line-P stations (see table below). All samples were acidified on board (1ml of 6N SeaStar Baseline HCl per 250ml of seawater) within a few days of sampling, Labile and total dissolved iron analysis' are to be completed on shore at a later date .

A minimum of one set of duplicates was taken at each station, salinities and nutrient samples were from the deepest bottle of each cast in order to help confirm the depth of sampling.

Sampling Summary for Fe, profiles

Depth	P04	P12	P16	P20	P26
0m					XX
5m					
10m	X	X	X	X	XX
25m	X	X	X	X	XX
40m	X	X	X	X	XX
75m		X	X		~~XX~~
100m		X	X		XX
150m		~~X~~	X		XX
200m		X	X		XX
300m		X	X		~~XX~~
400m		X	X		XX
600m					
800m		X	X		XX

Notes: Depths marked as ~~X~~ were not sampled as the Niskin didn't close properly, deep sample from P20 were not sampled as we were restricted for time due to weather.

David Capelle, Monica Torres-Beltran, Nina Schuback, Philippe Tortell (UBC) Line P – Feb 2012

Objectives:

Describe the taxonomic and metabolic diversity of the bacterial communities involved in the cycling of major nutrients and gases along Line P, focusing on the communities in the Oxygen Minimum Zone. Establish underway surface and depth distributions of the climate active gases nitrous oxide (N2O), methane (CH4), carbon dioxide (CO2) and dimethylsulfide (DMS), measure underway surface O2/Ar gas distributions to infer Net Community Production. Measure chlorophyll a fluorescence continuously along the ship's track using a Fluorescence Induction Relaxation (FiRe) system. This work is part of an on-going time-series program initiated in Feb. 2007.

Sampling plan:

Discrete measurements
At 5 stations (P4, P12, P16, P20, P26):

1) Count the number of cells per millilitre using Flow Assisted Cytometry at 16 depths.
2) Filter 1 L samples at 16 depths for high resolution bacterial DNA and sequencing.
3) Measure dissolved nitrogen (N_2), oxygen (O_2), carbon dioxide (CO_2), argon (Ar) and dimethyl sulfide (DMS) continuously at the surface using a membrane inlet mass spectrometer (MIMS).
4) At P4, P12 and P26, Filter 20L of water at 4 depths (10m, 500m, 1000m, and 2000m). 20L were filtered for in-lab genomic libraries and 20L were filtered to support the Earth Microbiome project. 2L were also filtered at these depths for RNA. Furthermore, Flow Cytometry data was also collected to support these samples as well as betaine preservation for single cell analyses.
5) At P4, P8, P12, P16, P20 and P26 we sampled water at 17 depths for in-lab measurement of dissolved nitrogen (N_2), methane (CH_4) oxygen (O_2), carbon dioxide (CO_2), argon (Ar) and nitrous oxide (N_2O) using a gas chromatography mass spectrometer (GCMS).
6) Collect samples for the analysis of variable chlorophyll a fluorescence (Fv/Fm). This is used a measure of physiological health of phytoplankton and can be used to infer rates of gross primary productivity.
7) 12x 20 L samples of filtered water (from P26) for analysis of Neodinium isotopes (for Roger Francois, UBC).

Continuous measurements
1) We installed our membrane inlet mass spectrometer (MIMS) to continuously (~ every 30 seconds) measure surface water concentrations of CO_2, O_2, Ar, N_2 and dimethylsulfide (DMS).
2) For the first time this trip, we also installed a FiRe system to measure chlorophyll a fluorescence profiles in surface water phytoplankton. We use an automated syringe pump and a flow through cuvette to introduce samples into measurement cell every ~ 10 seconds.

Comments:

The cruise was meant in part as a training exercise for three new students and also as a test of the FiRe system on the ship, running in continuous mode. Despite relatively poor weather (typical for winter), all of the students performed very well and were able to accomplish their research objectives. Torres-Beltran collected all of her discrete samples for molecular analysis and helped in the collection of dissolved gas samples. Schuback focused mostly on running the FiRe and was able to get good results despite low phytoplankton biomass. She also worked with Capelle and Tortell in making some refinements to the MIMS operating software. Specifically, new Labview software code was written to run the sampling valves autonomously. The instrument now performs calibrations automatically. This will help improve the accuracy of the underway measurements by correcting for instrument drift.

The laboratory space for the MIMS set up and molecular sample collections was similar to previous expeditions and very appropriate for our work. It would be helpful, however, to keep the lab doors closed when possible, to minimize temperature fluctuations in the lab. We have installed a temperature control system for the MIMS, which has helped stabilized the instrument, but further reductions in laboratory temperature variability would work. For this cruise, we set up the FiRe in the space normally occupied by the underway pCO_2. System. We realize that this space will not be available for future expeditions and we have thus made plans to install our FiRe in the web lab. These plans were discussed with Marie Robert and Kyle Simpson.

Monica Torres UBC Line P – February 2012

Objectives:
Describe the taxonomic and metabolic diversity of the bacterial communities involved in the cycling of major nutrients and gases along Line P, focusing on the communities in the Oxygen Minimum Zone.

Sampling summary:
At 5 stations (P4, P12, P16, P20, P26)

1) Gasses samples were taken for later dissolved nitrogen (N_2), oxygen (O_2), carbon dioxide (CO_2), argon (Ar), nitrous oxide (N_2O) measurement using Gas Chromatography Mass Spectrometry.

2) 15mL seawater samples were taken per depth to count the number of cells per millilitre using Flow Assisted Cytometry.
3) 15mL seawater samples were taken for hydrogen sulfide (H_2S) quantification an indicator of anaerobic respiration.
4) 1L seawater samples (at 16 depths) for high resolution bacterial DNA and sequencing were filtered.
5) Samples were taken and preserved with Betaine to perform a Whole Genome Analysis.

Additionally, at 3 major stations, (P4, P12, and P26) the following were sampled at four depths across the oxygen minimum zone

1) Large volumes (20L) per depth were filtered to create genomic libraries of the bacterial communities.
2) Gas samples were taken for later dissolved nitrogen (N_2), oxygen (O_2), carbon dioxide (CO_2), argon (Ar), nitrous oxide (N_2O) measurement using Gas Chromatography Mass Spectrometry.
3) Samples were taken and preserved with Betaine to perform a Whole Genome Analysis at P4 and P12. At P26 samples were preserved using *glyTE* for single cell DNA analysis. This enables genomic sequencing at a later date if promising results are found in those regions of the transect.
4) 15mL seawater samples were taken for hydrogen sulfide (H_2S) quantification an indicator of anaerobic respiration.
5) 15mL seawater samples were taken per depth to count the number of cells per millilitre using Flow Assisted Cytometry.

Comments:

It was a great experience being part of the cruise, it is a really good opportunity to learn from a very experienced scientific crew.

All our lab objectives for this cruise were successfully fulfilled. The work area distribution was very convenient for our sampling needs and we will try to use the same setup in future cruises.

Gas samples were taken, in duplicate at all depths at stations P4, P8, P12, P16, P20 and P26. Additionally, gas samples were also taken in duplicate at the 4 UBC depths at P4, P12 and P26.

Flow Assisted Cytometer has been already performed for all samples at UBC. Samples were taken at 16 depths from the IOS casts (P4, P8, P12, P16, P20) and 4 depths for the UBC casts (P4, P12 and P26). Hydrogen Sulfide quantification has been already performed for all samples at UBC. Samples were taken at 16 depths from the IOS casts (P4, P8, P12, P16, P20) and 4 depths for the UBC casts (P4, P12 and P26).

We wish to thank the Tully crew for their assistance and excellent work throughout the cruise. Thanks to Marie Robert and the scientists onboard for their help on deck and in the lab.

PROJECT TITLE

POC production, POC export and POC-^{210}Po-^{234}Th interactions in relation to plankton community structure in the subarctic NE Pacific

PI's: Gillian Stewart, City University of New York, Queens College, Flushing NY USA
Bradley Moran, University of Rhode Island, Graduate School of Oceanography, Narragansett, RI USA
Michael Lomas, Bermuda Institute of Ocean Sciences, St. George, BERMUDA

2012-01 February Line P Cruise Participants:
Roger P. Kelly, University of Rhode Island, Graduate School of Oceanography, Narragansett, RI USA
Gillian Stewart, City University of New York, Queens College, Flushing NY USA
Doug Bell, Bermuda Institute of Ocean Sciences, St. George, BERMUDA

OBJECTIVES and BACKGROUND

The overarching goal of this collaborative project is to investigate the relationship between variability in plankton community structure with variability in POC production, POC export and POC-^{210}Po-^{234}Th interactions in the subarctic NE Pacific.

This study is motivated by the need to illuminate the role of euphotic zone ecosystem processing in predicting the eventual fate of export flux in the mesopelagic. The project will provide a mechanistic understanding of the processes controlling the production and export of POC and associated elements in the upper subarctic Pacific. Specifically, we will investigate and directly test hypotheses on ecosystem processes

that link variability in plankton community structure to variability in particle production, export, and POC-210Po-234Th interactions in the upper ocean. We anticipate that outcomes from field work at Line P in conjunction with laboratory experiments will demonstrate strong and consistent relationships between planktonic food webs and the rates of carbon, ^{210}Po, and ^{234}Th packaging, sinking, and remineralization. Further, the information gathered will guide future use of radionuclide tracers, including mechanistic justifications for which tracer to use, when and where to use each tracer, as well as insight into the specific aspect of carbon that ^{210}Po and ^{234}Th are tracing. This project is relevant to several national and international research programs. These include: GEOTRACES, which is focused on the global-ocean distribution of trace elements and isotopes in seawater; and IMBER, which is focused on the structure and functioning of ocean ecosystems. This project will also build upon the results of earlier process studies at OSP including SUPER (Subarctic Pacific Ecosystem Research, Miller 1993), VERTEX (VERTical EXchange, Martin et al. 1987) and the Canadian JGOFS study. 18

SAMPLING:

At 5 major stations (P4, P12, P16, P20, and P26) two discrete rosette/CTD casts were made to collect seawater for our measurements. One cast was made for 234Th and 210Po samples, tripping bottles at 13 depths, of which 12 were fixed depths (5, 10, 20, 30, 50, 75, 100, 150, 200, 300, 400, 500m) and 1 was the chlorophyll maximum (DCM). The DCM was chosen based on observation of the instrument traces (fluorometer, transmissometer), which varied at each station but generally ranged between 40-60m. When no discernable fluorescence peak was observed, a depth near the midpoint of the surface mixed layer was selected. The second cast was for phytoplankton community structure and primary productivity samples. 7 depths were selected based on PAR light levels (100%, 50%,30%,17%,9%,5%,1%). Water samples were processed on board (described below) for later analyses at respective PI laboratories.

Phytoplankton structure profiles were measured from 7 depths based on PAR light levels.

- Fluorometric chlorophyll – 400-500ml filtrations each for “total” (GF/F filters, nominally 0.7µm) and 5 µm (polycarbonate membrane filters) size fractions in duplicate, stored in -80°C.
- HPLC pigments – 400-500ml filtrations each for “total” (GF/F filters, nominally 0.7µm) and 5 µm (polycarbonate membrane filters) size fractions, occasional duplicates, stored in -80°C.
- Flow Cytometry – 1.5ml samples preserved with 75 µl paraformaldehyde, stored in -80°C.
- Preserved microplankton – 200ml samples preserved with 10ml buffered formalin and 1 ml alkaline lugols solution, stored in the dark at room temperature.
- Particulate Organic C/N/P – 1L filtrations for total bulk POC/N/P(GF/F filters, nominally .7um) and .4um (polycarbonate membrane filters) for taxon-specific elemental composition.

Primary Production incubations were conducted at P4, P16, and P26. Net primary production measurements were made at 7 light depths of (100, 55, 30, 17, 8, 5, 1.5%) from 3 light bottles and 1 dark bottle. Activity used in each 250ml PC incubation bottle was assumed to be 12.5uCi. Bottles were stored in mesh “light” bags of predetermined PAR for 24hrs in an incubation tank, with “science” sweater continuously flowing through the incubator. Filters were acidified for storage and specific activity was taken for each light depth for initial and final activities. Specific activity samples were preserved using 250ul of phenylethylamine.

Thorium profiles were measured on 12 depths (DCM, 1, 10, 20, 30, 50, 75, 100, 150, 200, 300, 500m). 4L samples were pH adjusted with 8 drops 28% NH_4OH then 25 µl 0.2M $KMnO_4$ and 10 µl 1 M $MnCl_2$ to form a MnO2 precipitate which was collected on GM/F filters. The filters were stored frozen (-20C) and brought to URI-GSO for analysis by direct beta counting.

Polonium profiles were measured on a subset of 10 depths. Whole-rosette bottle samples (10.1 L) were drained into 20L cubitainers (contained in milk crates for easier handling). Samples were pH adjusted with HNO_3 then spiked with 25 µl ^{210}Po tracer, 1 ml Pb standard and 5 ml $FeCl_3$. Samples were pH adjusted again with NH_4OH, oxidized with 1 ml $NaCrO_4$, and pH increased again with more NH_4OH. Samples were allowed to precipitate and sediment for at least 10-12 hours. Samples were decanted to ~1L and transferred, with most of the precipitate to LDPE bottles.

***In-situ* pumps** were deployed at P4, P12, and P26 for collection of size-fractionated particles and dissolved Th-234. Three McLane and one Challenger pumps were deployed for 4 hours (0.5 hour delay, 3.5 hour pump time) to sample particles (>53, 53-10, 10-1 µm nitex screens) at 30, 50, 100, and 200 m. Upon recovery, the nitex screens were rinsed and sonicated to extract the particles, which were then filtered onto precombusted GF/F filters for organic carbon, thorium, polonium, and pigment analysis. Manganese-oxide absorber cartridges were used to collect large-volume dissolved thorium samples.

Sediment traps were not deployed near P26

Samples collected	P4	P12	P16	P20	P26
Total Chlorophyll	11	11	11	11	22
5 µm Chlorophyll	11	11	11	11	22
Total HPLC	11	11	11	11	22
5 µm HPLC	11	11	11	11	22
FCM	7	7	7	7	7
Preserved Microplankton	4	4	4	4	4
Primary Production	1	X	1	X	1
Total $_{234}$Th	12	12	12	12	12
Total $_{210}$Po	11	11	11	11	11
Bongo Tow	2	2	2	2	2
In-situ pumps	4	4	X	X	4
Sediment traps	X	X	X	X	X

RADIOISOTOPE USE:

The following radioisotope was used in the Rad-Van: $H^{14}CO_3$, A single daughter stock was created with a volume of 30mls and total activity of 55.5MBq. A total of 4 wipe tests were conducted over the cruise. The first test was conducted before the stock was opened (2/6/12) on the ship. The second test was conducted after 1 week on the ship (2/13/12), and a third test was conducted after the final incubation and disposal of remaining daughter stock (2/18/12). The final wipe test was made once we docked at IOS (2/20/12). There were no incidences to report with any level of contamination. The only radioisotope left behind is the main stock(1.5ml – 55.5MBq remaining), kept at IOS for future cruises.

RADIATION VAN REPORT:

Overall, the van was great to work in. The floor mats had been removed after previous suggestion, which kept the floor easy to clean and free of any contamination. Window covers were provided for light reduction, but they are rather difficult to snap into place. A scintillation counter was provided by IOS for wipe tests, however a stable power connection was difficult to maintain. This was noted before initial use of instrument and issues with power did not allow wipe tests to be read between 2/13-2/16, until a ship engineer was able to repair a faulty wire connection. After this repair, the instrument worked fine.

SUMMARY/FINAL COMMENTS:

Thanks to the officers and crew of the John P. Tully for a successful cruise. Thanks and appreciation to the bosun and deck crew for assistance securing and deploying our equipment on the weather decks. We would also like to thank Marie Robert and the science party for their sampling assistance. Thanks to Mike Arychuk for assistance with inter-cruise chemical storage and handling. We'd also like to thank Darren Tuele, Janet Barwell-Clarke, and Hugh Maclean for help during pre- and post-cruise operations.